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Measuring Multidimensional Rural Poverty using Combination of Methods – A Case Study from Southern Ethiopia

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Abstract
This paper focuses on the development and empirical application of a multidimensional measure of wellbeing index which can be used to assess level of poverty among households in rural areas of developing countries. The study employed community-based participatory and questionnaire-based household survey data collection methods. The final multidimensional index was derived using a Principal Components Analysis (PCA) on household survey data set collected from 358 rural households in Southern Ethiopia. Data on 16 variables measuring multiple aspects of household wealth status were used to extract the set of principal components utilized in the construction of the index. Two key statistical tests, the KMO and Bartlett's tests, showed the appropriateness of the data for PCA. Results revealed that four major factors influence the wealth status and hence the wellbeing of households: *household natural resource endowment, assets endowment, human capital and access to institutional support and proxy to physical market.* Therefore, we suggest that any efforts to improve the wellbeing of farm households in the study area as well as in other regions with similar socio-economic and biophysical settings should consider these factors as entry point to poverty alleviation.
Keywords: Multidimensional wellbeing; Principal components analysis; wealth index; Farm households; Halaba

1. Introduction

Conventional measures of household wellbeing use household level income or consumption expenditure data overtime time or at a point in time (Vyas and Kumaranayake, 2006). However, collection of accurate income and consumption data requires extensive resources and suffers methodologically in the context of developing countries as it depends on the memory of respondents in recalling income and expenditure amount for relatively long period of time. In addition, farm households' participation in monetary transaction through selling their produces and buying goods and services is rather limited. The subsistence nature of farm households has weaken the income or consumption based measurement of wellbeing. On the other hand assets-based multidimensional measure of wellbeing overcome the limitations of monetary metric oriented measurements and suitable to measure the wellbeing of subsistence farm households. The use of asset indices as proxies for welfare, wealth, economic status and/or living standards has rapidly become very popular in social epidemiology and development studies following the seminal articles by Sahn and Stifel (2000) and Filmer and Prichett (2001), who introduced the method in the context of the analysis of poverty, wealth and their correlates in low and middle-income countries.

The main advantage of multidimensional measure of wellbeing over the classical income or consumption based approaches is that the former avoids many of the measurement problems associated with the classical method, such as recall bias and seasonality. This method may be very important for subsistence farm households in developing countries who are not only passive participants of monetary oriented transactions, but also do not keep records on their incomes and expenditures.

In the absence of accurate incomes or household expenditure data, a number of poverty studies have used the Principal Components Analysis (PCA) method for creating an asset-based index of household wealth[1] status (Azzari et al. 2005; Mastromarco et al. 2010). Filmer and Pritchett (2001) used household asset variables to show that the relationship between wealth and enrollment in school can be estimated without income or expenditure data. PCA provides acceptable and reliable weights for an index of asset to serve as a measure for wealth (see Sricharoen and Buchenrieder, 2005; Xhafaj and Nurja, 2015**).** Given the increasingly routine application of PCA using asset data in creating socio-economic status (SES) indices, the present study applied multidimensional measure of wellbeing using selected assets-based variables obtained from series of participatory studies and a survey of farm households in Southern Ethiopia.

In addition to the methodological advantage, asset based measure of household wealth status embodies aspects of subjective criteria of wellbeing in a participatory environment. The method also provides localized

[1] It is assumed that greater wealth causes greater wellbeing (see, for example, Robert, 2012). Thus, wealth and wellbeing were used interchangeably throughout the paper.

and context-based evidence to target effective interventions for poverty alleviation. However, due to lack of evidence on localized and context specific poverty/wellbeing indicators, a number of development interventions are based either on a coarse national level data or on global figures such as the '$1.5 per person per day' measure of poverty. The key motivation of this study is to fill the knowledge gap, using a series of participatory field works on a range of local poetry/wellbeing/wealth assessments and rural household surveys in Halaba Special District in Southern Ethiopia

2. Review of literature

Various studies have shown that the majority of people in Ethiopia are among the poorest in the world (Dercon and Krishnan, 1998; Rahmato and Kidanu, 1999; World Bank, 2001; and Bogale, 2005). The severity of poverty in Ethiopia could be better understood and uncovered when one examines welfare indicators such as life expectancy, access to clean water, access to electricity, under five stunting, access to education and basic necessities of life. A recently released World Bank Report (2015) indicates that despite impressive improvement in the last decade, Ethiopia remains a long way to go to improve the welfare of its citizen. The Report indicated that 31% of the Ethiopian population still living on less than the international poverty line, half of the population lead a life without education, 77% do not have access to electricity, 66% lack access to piped water, 44% of under five children affected by stunting, only 37% of rural women received antenatal checkup and life expectancy is about 63 years (World Bank, 2015). Many studies on poverty in Ethiopia (World Bank, 2004; Schreiner and Chen, 2009; Girma, 2013; MoFED, 2013; World Bank, 2015) investigated the nature of poverty in Ethiopia at various scopes and using different methodological approaches.

Most of the poverty studies conducted in Ethiopia focus on money metric (income or consumption) and food entitlement (Tadesse, 1999; EDRE, 2000). On the one hand, majority of the people, particularly in rural areas of the country, are illiterate and rarely keep record of their expenditure and/ or income; and also the households may have multiple sources of income that makes it difficult for a researcher to find information about income and/or expenditure because of their seasonality and difficulty of memorization. As a result, it is highly likely that this conventional measure of poverty produces inaccurate poverty assessment. As numerous authors have remarked, the three widely applied approaches of poverty measure i.e., money metric, capability and social exclusion poverty assessments, were criticized for being externally imposed and failing to take into account the views of the poor people (Caizehu Lu,2012; Schreiner and Chen, 2009; Zeller et al., 2006). Therefore, participatory poverty assessment, in particular revealing the perspectives of the poor by involving their views and perception in defining poverty and what it means to be poor and the magnitude of poverty is demanding an alternative approaches. The rationale of employing alternative approach is the fact that the popularity of participatory poverty assessment through wealth ranking and Principal Component Analysis (PCA) has greatly increased in the last decade and a growing number of development actors are adopting the alternative approach (Ruggeri, 2001; Nurja, 2015; Hoque, 2014; Vyas and Kumaranayake, 2006). In fact all societies, regardless of whether they are affluent or less privileged, have their own conceptualization of wellbeing and what defines wellbeing are not necessarily dependent only on measured money income. In a participatory wealth ranking exercise which is commonly practiced in developing countries, key informants from the local communities rank their fellow villagers into different wealth position and wealth categories. This exercise help bring out the complexities and realities of wealth and poverty dynamics rather than using definitions predetermined by the researchers alone (Jeffries et al, no date).

3. Methodology

3.1. Description of the study area

The study area, Halaba Special *woreda*[1] *(*ca. 640 km^2*)*, located at 07^{0}17'N and 38^{0}06'E, is found in the Southern Nations, Nationalities and People's Regional (SNNPR) State in Ethiopia (Figure 1). Unlike the ordinary *woreda*s which are accountable to their respective Zonal administrations, the special *woreda* enjoys a special privilege of self-administration and its accountability is directly to the SNNPR. The total population of the *woreda* is estimated about 287,802 people of which about 88% are rural residents (HWOFED, 2013). Agriculture is the mainstay of the *woreda* with two types of farming systems: *Teff (Eragrostis tef)*-bean and pepper-livestock systems. The altitude ranges from 1,700 to 2,150 m.a.s.l. and annual rainfall varies from 857 to 1,085mm with the annual mean temperature of 17^{O}C to 25^{O}C. Rainfall is a major limiting factor in agricultural production and is bimodal, with a small rainy season between March and April while the main rain take place between July and September. In terms of agro-ecological classifictaion, the *woreda* is dominantly classified as semi-arid *woina-dega*[2]**.**

The study Woreda was selected as the main project site in Ethiopia for the "Alternative Carbon

[1] 'Woreda' the Amharic equivalent to 'District' in English.
[2] '*Woina-dega'* is an agro-ecological classification in Ethiopia covering altitudes between 1500 to 2300 m.a.s.l.

Investments in Ecosystems for Poverty Alleviation: below-ground versus above-ground opportunities for the restoration of ecosystem services (ALTER)" project[1]. The rationale for choosing Halaba is that the SNNRP's Agricultural Bureau together with development agencies have been investing significant resources to rehabilitate the severely degraded natural resources in the area, particularly to improve the productive capacity of soils and local livelihoods. In terms of agro-ecosystems research in the area, the Southern Agricultural Research Institute (SARI), Hawassa University, and the Halaba Agricultural Office have been working with the local communities on soil restoration in the Woreda. The Halaba watershed (ca. 100 km2) is a typical landscape with a diverse land uses of cropping (including teff, maize, potatoes, beans, pearl millet, etc), grazing lands, woodlands/plantations and degraded areas with the Bilate River bisecting the area.

A major aspect of this study is to establish a link between the wealth status of households and their dependence on natural ecosystem using multi-dimensional wealth index where natural assets constitute a major part. To this end, the study covers three sampled '*kebeles*[2]' of the woreda –Laygnaw Arsho, Assore and Andegna Choroko (Figure 1) – with different natural resources endowment and management regimes. Laygnaw Arsho is located in the South west part of the *woreda* with a total area of 1419 ha. It is characterized by hilly area (80%) and flat land (20%). The hills are highly degraded and the past efforts have brought significant changes in restoring the area. Of the degraded hilly area, estimate indicated that about 25% is covered with trees, shrubs and grass while about 25% of the area is covered with grass with few trees and the remaining area is with no vegetation cover. Assore, the second sampled kebele, is located in the southern part of the *woreda*. The total area of the kebele is 761 ha; of which 570 ha is cultivated. A total of 112 ha is under area closure; the remaining 80 ha is occupied by perennials, gullies, institutions (schools, government offices, health institutions etc) and roads. Land degradation was high but now has been restored successfully. Andegna Choroko, the third kebele, is located in the northern part of the *woreda*. It has a total of 884 ha and most part is characterized by flat land (70%) and the remaining is gentle slope (30%). Significant part of the kebele (252 ha) is covered by trees, shrubs and grass and put into use, the community is deriving significant income from the area.

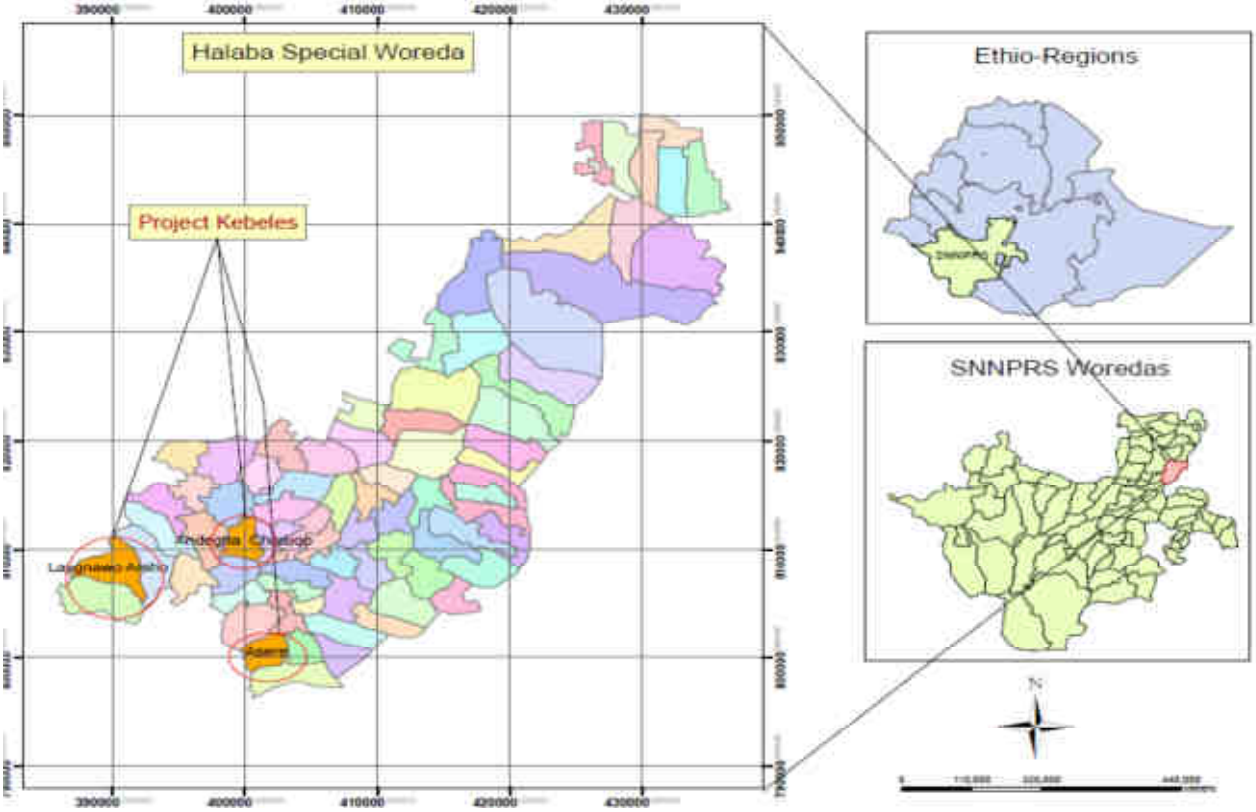

Figure 1. Location of the study area

3.2. Conceptual framework

[1] ALTER is a 3 year project being implemented in Ethiopia and Uganda and funded by the 'Ecosystem Services and Poverty Alleviation (ESPA)' research programme (the UK). ESPA is a research programme delivering evidence and tools which will create a more sustainable link between land and livelihoods in the world's poorest countries.
[2] '*kebele*' is the smallest administrative units in Ethiopia. It is a subset of a '*Woreda*' (i.e., District).

Three key issues that are crucial to the discussion on conceptualizing poverty have been debated in poverty literature. The first is a definitional concern with narrowly defined (income-based) versus broad multidimensional (income and non-income factors) notions of poverty; the second is a technical concern with the measurement of poverty, specifically, the use of quantitative methods versus qualitative methods; and the third is an empirical concern with "chronic poverty" versus "transitory poverty" (Devereux, 2003).

With regard to definitional issue, the concept of poverty swing like a pendulum from the 'welfarist' versus 'non-welfarist' (Ravallion 1994), and 'functioning' and 'capabilities' perspective Sen (1985). The welfarist tries to conceptualize poverty from utility angle derived from individual preference and choices. The non-welfarist approach, on the other hand, focuses on the attainment of certain basic achievements, such as food, clothing and shelter or buddle of goods and services. According to Sen, Welfare is seen from the perspectives of 'functioning' and 'capabilities'. 'Functioning' is an achievement and 'capability' is the ability to achieve. 'Functioning' is related to the state of existence of a person such as whether a person is well nourished, clothed, educated or participates in society without shame. Capability, on the other hand, has to do with an individual's freedom in the choice of their life and 'functioning'.

Concerning the measurement of poverty, the analysis of poverty is increasingly conducted using both qualitative and quantitative methods and popularly known as mixed methods (Creswell, 2003; Kanbur, 2003; Moser and Felton, 2007). Quantitative methods are thought to be desirable given their probabilistic nature, possibility of replication and designing spatially and temporally comparable research subjects. However, quantitative analyses are relatively weak in generating an understanding of the deeply embodied perception and articulation. Moreover, it hides unexpected results and diversity through statistical averages. Qualitative methods of textual and normative, allow investigation of issues in an in depth, exploratory and more holistic manners. They are particularly useful in understanding casual processes, permit opportunities for unexpected factors and allow explanation through probing.

Poverty persist overtime or last short depending the underlying forces. The best way to learn the nature of poverty from temporal dimension is through panel data. Depending on the nature of the incidence of poverty over time, it could be chronic and transitory.

Against this background, this paper employed a mixed methods and multi-dimensional wealth indices using cross-sectional data (see Figure 2). Despite the apparent advantage of employing mixed approaches, it can argue that asset indices must be approached cautiously. Specifically, in any one setting, the assets to be included in the index must be selected carefully and the technique used to compile it must be applied with caution.

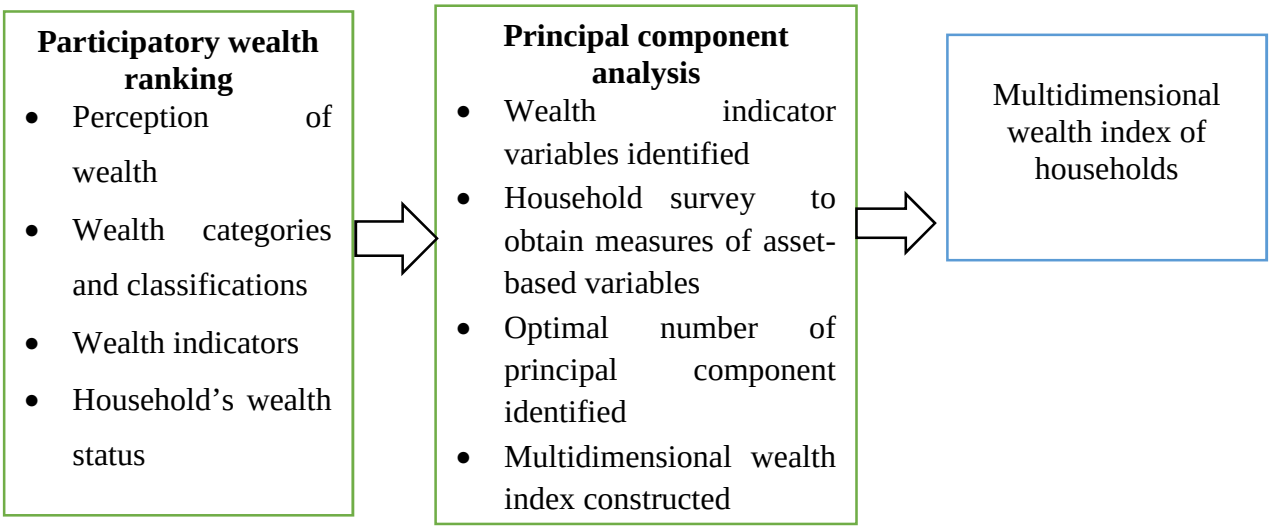

Figure 2. Conceptual framework used in the study

3.3. The data

Primary data (both qualitative and quantitative) were collected from the three kebeles described in section 3.1. The first step in the data collection was participatory wealth ranking. The wealth ranking exercise using focus group discussion resulted in identification of local wealth indicators while the key informants interview define the wealth position of households as per the indicators. Following the wealth ranking a detailed survey schedule prepared to collect quantitative data on the indicators already identified in the qualitative methods and other background characteristics of households. A random sample consisting of 358 households were selected using probability proportional to size sampling techniques. Trained enumerators administered the survey and field

work was supervised on a day-to-day basis by the research team to ensure enumerators' compliance with established survey procedures.

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3.4. The methods of PCA

PCA transforms the original set of variables into a smaller set of linear combinations that account for most of the variations of the original data set. The principal components are extracted so that the first principal component accounts for the largest variation in the data, the second principal component accounts for the second largest variation in the data, and so on . We used PCA method to derive nine principal components out of the 16 possible poverty indicators variables reflecting household wealth status.

In mathematical terms, from an initial set of n correlated variables, PCA creates uncorrelated indices or components, where each component is a linear weighted combination of the initial variables. Let us consider the variables $X_1, X_2,...,X_n$. A principal component analysis of this set of variables can generate p new variables, known as the principal components, $PC_1, PC_2,...,PC_m$. which can be expressed as follows:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots + +a_{1n}X_n$$
$$\vdots \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$
$$PC_m = a_{m1}X1 + a_{m2}X_2 + \ldots + a_{mn}X_n$$

Where a_{mn} represents the weight for the m^{th} principal component and the n^{th} variable. Following equation 1, the principal components were computed from the empirical model for the estimation of household wealth index. Table 1 presents the 16 variables used in the PCA.

Table 1. List of variables originally entered in PCA analysis

Variable	Obs.	Mean	Std. Dev.	Min	Max
Agricultural assets value	358	715.15	1688.60	0	13199
Household assets value	358	2696.87	5004.81	27	56090
Bank account	358	0.18	0.38	0	1
Total landholding size	358	1.15	0.64	0.13	5.5
Annual crop produce value	358	16467.75	36623.82	0	608095
TLU	358	13.62	6.20	0	28
Investment in agricultural inputs	358	1843.90	1392.50	0	7488.1
Number of family members who are in active age group	358	3.23	1.49	1	10
Gender of household head	358	0.79	0.41	0	1
Perennial crop produce value	358	5402.88	13283.36	0	119000
Value of livestock owned	358	9540.76	8909.38	0	65160
Percentage literate household members	358	44.42	25.59	0	100
Percentage of household members engaged in nonfarm activities	358	7.34	22.21	0	250
Source of drinking water	354	5.33	1.24	1	7
Source of fuel wood	354	2.02	0.29	1	3
Access to credit	358	0.47	0.50	0	1

The principal component analysis (PCA) retained 9 out of 16 variables (Tale 2). Three of the 9 variables relate to the agricultural resources endowment: (1) investment on agricultural inputs such as fertilizer, improved seeds and chemicals, (2) total landholding size, (3) livestock holding value. There are two variables relating to assets value: (4) agricultural asset value and (5) household asset value. Two variables relating to human capital capacity at household level identified. These are the (6) percentage of literate household members and (7) number of household members aged between 16 and 64. Two variables related to access to services and market: (8) frequency of contact with extension agents and (9) distance of the household from district town.

Table 2. The nine variables extracted as principal components

Variables	Unit of measurement	Expected influence on household wealth status
Investment in agricultural inputs	Ethiopian Birr (ETB)	+
Total landholding size	Hectare	+
Value of livestock holding	ETB	+
Agricultural assets value	ETB	+
Household assets value	ETB	+
Number of family members who are in active age group	Number	+
Percentage literate household members	Percentage	+
Frequency of extension contact	Number	+

Distance from Home to district town	Hour	-

3.5. Descriptive results

The participatory wealth ranking exercise revealed that wealth is multidimensional and broader than the conventional income or consumption based broad enough to include material, spiritual, intellectual, political, and quality of life aspects of poverty. The material aspects of wealth identified by the focus group discussants encompass flows and stock. The flows aspects capture income and liquid assets recurring periodically while the stock comprises assets accumulation and buffer such as livestock, house, land, savings etc. Some discussants define wealth from spiritual perspective and they believe it is determined by the 'will of God'. Wealth also associated to outcome of intellectual ability, political decision, peace at macro and micro level and individual competence such as hardworking and positive attitudes.

Looking at wealth perception between gender, the finding reveals that men and women perceive wealth differently. In the men group discussants perceived that wealth encompasses quite a number of dimensions: knowledge, landownership, animal ownership, good health, access to natural resources, peace and stability, positive thinking and hardworking. Women group participants perceived wealth as having a land to work on, having animals, money, eating three times per day, having lactating cows, peace and good health.

The descriptive figures shown in Table 3 indicates that residents in Andegna chroko kebele are better off in agricultural and household assets, investments in agricultural inputs such as fertilizer and seeds, labor endowment, literacy extension contact and located in close proximity to town. Residents in Asore kebele were also found to be in a better position compared to that of Laygnaw Aresho kebele though the households in the latter are better off in certain wealth indicators such as literacy and value of household durable assets than the Asore dwellers.

Table 3. Comparative statistics of the data by kebele

Variables	Study kebele			Total Mean (SD)
	Andegna choroko	Asore	Laygnaw aresho	
Agricultural assets value in Birr	840.20	818.27	557.67	715.15 (1688.60)
Household assets value in Birr	3948.96	2078.39	2169.66	2696.87 (5004.81)
Investment in agricultural inputs in Birr	2372.15	1897.56	1421.46	1843.90 (1392.50)
Total landholding size in ha	1.20	1.39	0.97	1.15 (0.64)
Value of livestock holding in Birr	9154.17	10015.89	9522.87	9540.76 (8909.38)
Number of family members who are in active age group (15-64 age)	3.41	3.16	3.15	3.23 (1.49)
Percentage literate household members	54.20	32.40	44.87	44.42 (25.59)
Frequency of extension contact	37.40	19.78	5.42	19.18 (34.86)
Distance from home to district town	0.49	1.82	2.07	1.51 0.81)

3.6. Statistical tests of the appropriateness of PCA

In the present study, the Kaiser-Meyer-Olkin (KMO), a Measure of Sampling Adequacy (MSA) was used to detect multicollinearity in the data so that the appropriateness of carrying out a principal component analysis can be justified. The KMO statistic, also called the measure of sampling adequacy, indicates whether the correlations between variables can be explained by other variables in the dataset and KMO values greater than 0.70 are usually considered as appropriate (Mooi and Sarstedt, 2011). The KMO measure compares the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. If the variables, in fact, have common factors, the partial correlation coefficients should be small relative to the total correlation coefficient. The maximum value of KMO can be 1.0, a value of 0.9 is considered as 'marvelous', 0.80, 'meritorious', 0.70, 'middling', 0.60, 'mediocre', 0.50, 'miserable' (Antony & Rao, 2007; see also, Planning Commission, 1993). For our data, it was 0.691, signaling that a factor analysis of the variables can be recommended. The results of the present study showed that the value of KMO is 0.711 and is relatively high, that means that the data are suitable for the Principal Components Analysis and the appropriateness of the model which is within an acceptable range for a well specified model and which good to warrant interpretation of results (Krishnan, 2010).

Another test of the strength of the relationship among variables was done using the Bartlett's (1954) Test of Sphericity. The Bartlett's Test of Sphericity tests the null hypothesis that the variables in the population correlation matrix are uncorrelated.

Similarly Bartlett's Test of Sphericity howed a significance level of 0.00, a value that is small enough to reject the hypothesis (the probability should be less than 0.05 to reject the null). It can be concluded that the strength of the relationship among variables is strong or the correlation matrix is not an identity matrix as is required by factor analysis to be valid. These diagnostic procedures indicate that principal component analysis is appropriate for the data.

Table 4. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.711
Bartlett's Test of Sphericity	Approx. Chi-Square	915.35
	df	36
	Sig.	.000

When PCA is used, we have the option of using either the correlation or the covariance matrix. Because the variables were not standardized, the correlation matrix was used as an input to PCA to extract the factors. As noted by Bolch and Huang, (1974) PCA is sensitive to differences in the units of measurement of variables, since the correlation matrix is the standardized version of the covariance matrix, a correlation matrix should be used, if standardization of variables was not done.

Communalities rule was tested against originally included 16 variables and only 9 was fulfilling the criteria and maintained for the final PC analysis. Communalities represent the proportion of the variance in the original variables that is accounted for by the factor solution. The factor solution should explain at least half of each original variable's variance, so the communality value for each variable should be 0.50 or higher. Hence, as indicated in Table 5 all the nine variables communality value was higher than 0.5.

Table 5. The results of communalities for identifying variables to be included in the final PCA

Communalities		
	Initial	Extraction
Investment in agricultural inputs	1.000	.736
Total landholding size in ha	1.000	.771
Value of livestock income	1.000	.666
Agricultural assets value	1.000	.831
Household assets value	1.000	.773
Family members who are in active age group	1.000	.700
Percentage literate household members	1.000	.792
Frequency of extension contact	1.000	.720
Distance from Home to district town	1.000	.731
Extraction Method: Principal Component Analysis.		

The number of factors extracted can be defined by the user, and there are techniques available in SPSS that can be used to help decide the number of factors. One of the most commonly used techniques is Kaiser's criterion, or the eigenvalue rule. Under this rule, only those factors with an eigenvalue (the variances extracted by the factors) of 1.0 or more are retained. Using this criterion, our data revealed 4 factors.

Table 6. Principal components and variance explained

Total Variance Explained									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum.%	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	3.12	34.65	34.65	3.12	34.65	34.65	2.232	24.81	24.81
2	1.43	15.91	50.57	1.43	15.91	50.57	1.780	19.77	44.58
3	1.12	12.50	63.06	1.12	12.50	63.06	1.500	16.67	61.24
4	1.05	11.60	74.65	1.05	11.60	74.65	1.207	13.41	74.65
5	.703	7.81	82.47						
6	.555	6.17	88.63						
7	.456	5.07	93.70						
8	.292	3.25	96.95						
9	.275	3.05	100.00						
Extraction Method: Principal Component Analysis.									

For the present study, we also used a graphical method, known as the Catell's (1966) scree test (Figure 3). These are plots of each of the eigenvalues of the factors. One can inspect the plot to find the place where the smooth decrease of eigenvalues appears to level off. To the right of this point, only 'factorial scree' (meaning debris which collects on the lower part of a rocky slope) is found. After examining the scree plot, only four factors were extracted for analysis.

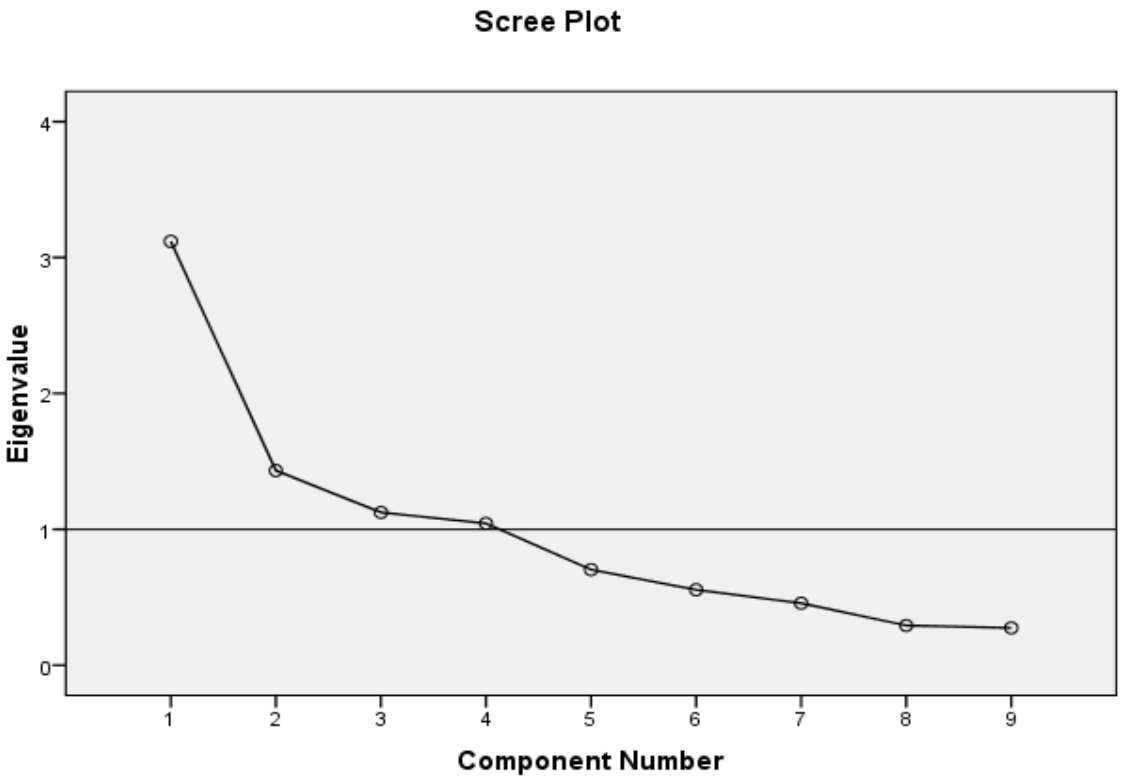

Figure 3. Scree plot

4. Results

The results of PCA using varimax rotation are presented in Table 6. Four factors accounted for 74.65 per cent of the total variance in the data retained for the construction of household wealth status following the rule of Eigenvalues greater or equal to one. For the first factor that accounts for nearly 35% the variation; investment in agricultural inputs, total landholding size, and value of livestock holding showed markedly higher positive loadings. In the second factor agricultural and household asset value implicate a positive loading. In the third loading family members who are in active age group and percentage literate household members showed a positive loading. In the fourth factor frequency of extension contact showed a positive loading while distance to district town turn out a negative loading implying households who are furtherer located from district town are less wealthy.

The results of the PCA analysis clearly shows that there are four major factors influencing wealth position of the households. The first factor is ***natural resource endowment*** of the households. Under this the landholding size of the household contribute the highest loading value and positively influence wealth status (Table 7). Following, the ability of the household to finance purchase of agricultural inputs such as mineral fertilizers, improved seed and pesticides contribute the second highest positive loading value. Livestock holding value measured in Birr is also one of the critical resource endowments in the study area. Livestock played multidimensional roles in the wellbeing of households as it is easily converted into liquid cash at the time of financial shortage, provide draft power, manure and nutritious food and it contributed positively to the resource endowment factor.

The second factor accounted for about 16% of the variance. We may interpret this factor as a measure of the ***asset holding*** value. Agricultural assets value measured by aggregating the major agricultural implements value such as plough, sickle, axe and animal pulled cart. In similar manner the household assets value comprises the sum of the value of chair, table, radio, bed, motorbike, watch, mobile, TV, etc. Both agricultural and household items asset value contribute positively and considerably to the second factor.

The third factor is a reasonable representation of ***human capital*** development. It measures both the physical labor availability and the quality of labor measured using educational attainment. Households having active labor force ready to work have opportunities to accumulate wealth as compared to households having large proportion of dependent and ready to consume. Large percentage of literate members at household level also enhance decision making, efficient resource allocation, choice of enterprises and information synthesis and technology utilization. Hence, labor availability and literacy level of household members influence wealth status

positively and considerably.

The fourth factor accounted for 11.60% of the variations and explains ***access to institutional support and market***. Frequency of contact with extension agents implies better access to agricultural information and efficient utilization of agricultural technologies through technical backup, which improves productivity and income from agriculture. Proximity to district town also provide better access to market and price information. As a result households closely located to district town have a better opportunity to access market and information which ultimately influence the household wellbeing.

Table 7. Rotated principal component matrix

Rotated Component Matrix [a]				
Variables	***Component***			
	1	***2***	***3***	***4***
Investment in agricultural inputs	**.731**	.276	.350	.049
Total landholding size in ha	**.826**	.245	.113	-.125
Value of livestock income	**.721**	.338	-.144	.107
Agricultural assets value	.227	**.883**	-.012	-.022
Household assets value	.283	**.814**	.083	.152
Family members who are in active age group	.557	-.185	-.099	**.587**
Percentage literate household members	-.077	.170	.128	**.861**
Frequency of extension contact	.201	-.083	**.812**	-.116
Distance from Home to district town	.087	-.131	**-.807**	-.235
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 7 iterations.				

5. Computing the socioeconomic index

Following the method used by Krishnan (2010) the household wealth status is determined as follows: As a first step in the computation of a single index, factor score coefficients, also called component scores were estimated using regression method. Factor scores are the scores of each sample household, on each factor. To compute the factor scores for a given case for a given factor, the case's standardized score on each variable is multiplied by the corresponding factor loading of the variable for the given factor, and summed these products. This calculation was carried out using SPSS procedure and factor scores were saved as variables in subsequent calculations involving factor scores.

The four factors explained 74.65 per cent of the total variation, with the first, second, third, and fourth factors, explaining 34.65, 15.91, 12.50, and 11.60 percents respectively. Therefore, the importance of the factors in measuring overall wealth position is not the same. Using the proportion of these percentages as weights on the factor score coefficients, a Non- standardized Index (NSI) was developed for each cases using equ.2:

NWS = (34.65/74.65) (Factor 1 score) + (15.91/74.65) (Factor 2 score) + (12.50/74.65) (Factor 3 score) + (11.60/74.65) (Factor 4 score) ……(2)

This index measures the socioeconomic status of a household relative to the other on a linear scale. The value of the index can be positive or negative, making it difficult to interpret. Therefore, a Standardized Index (SI) was developed, the value of which can range from 0 to 100, using equ.3:

$$WS=\frac{NWS\ of\ HHi - Min\ NWS}{Max\ NWS - Min\ NWS} * 100 \quad \text{……..(3)}$$

The scores ranged between 0 and 1and make the interpretation easier; the higher the value, the better the wealth status of the household. Considering the mean wealth status (0.3) index and standard deviation (1), three wealth category groups are formulated; Mean – SD (the lower wealth status category), Mean +SD (better off or high wealth status category) and between the two categories i.e. Mean –SD and Mean +SD, (the middle wealth category).

The distribution of household wealth position in the study area show that the majority of households fall under low wealth status followed by middle wealth status while the better of households are fewer in proportion.

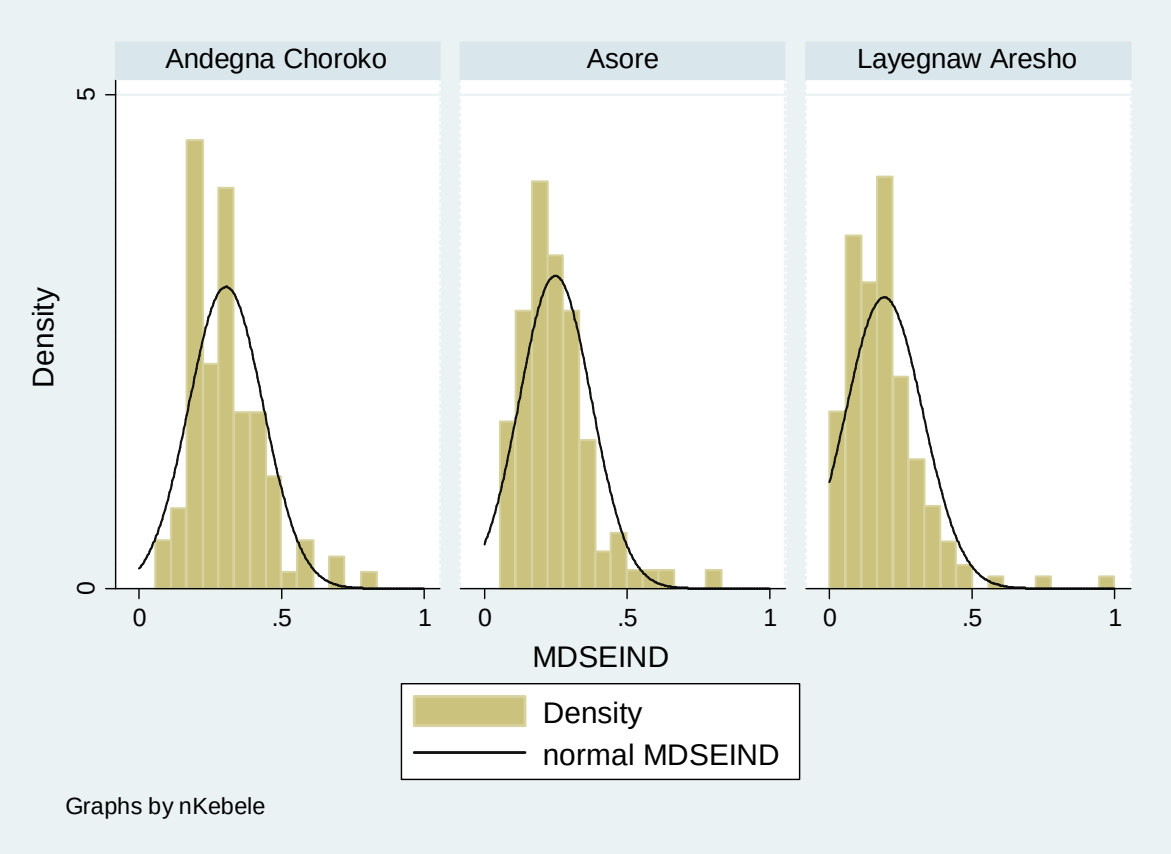

Figure 3. Wealth status distribution of households in the study kebeles

The findings of the study showed that wealth status of the sample households were significantly different across the study kebeles at 1% level. Compared to the other two kebeles, large percentage of households residing in Andegna Choroko are better off (22%). The proportion of low wealth status categories was high in Layegnaw Aresho (70%).

Table 8. Wealth status of households in the study kebeles

Poverty status	**Wealth status distribution**				
	The study area	The study kebeles			Pearson chi2(4)
		Andegna choroko	Asore	Layegnaw Aresho	
Poor	52.51%	32%	48%	70%	43.3***
Medium	35.47%	45%	43%	24%	
Better off	12.01%	22%	9%	6%	
Total number of households=358					

6. Conclusion and policy implications

This paper used PCA to create a wealth status index of households. The main advantage of this method over the classical methods based on income and consumption is that it avoids many of the measurement problems associated with the classical method, such as recall bias and seasonality. This method may be very important for poor countries and subsistence farm households which not only passive participants of monetary oriented transactions, but also do not keep records on their income flows and expenditures.

Combing participatory wealth ranking exercise with principal component analysis found to be an effective complementary and least cost alternatives in measuring poverty or wellbeing in the data scarce rural areas in the developing world. Because this non-monetary based approach provides better measures and insights compared to income or consumption based approaches as subsistence oriented smallholders are less integrate into monetary economy. In line with this argument, the study revealed that four major factors influence the wealth status of households: household natural resource endowment, assets endowment, human capital and access to institutional support and proxy to physical market. Households who have better off in this four major factors are wealthier than those who constrained on these factors. Therefore, we suggest that any efforts to improve the living standard or wellbeing improvement of farm households in the study area as well as in other

regions with similar socio-economic and biophysical settings should work on these factors as entry point to poverty alleviation.

Based on the findings two major policy implications have been drawn: (1) asset based wellbeing analysis is an effective measure in capturing the relative positions of households within a community and can be used as local specific tool in differentiating poor from non-poor for development intervention targeting, (2) poverty targeted alleviation should consider household level asset building (natural, physical, human and institutional assets) as an effective policy instrument to combat rural poverty. This is signifies the need to understand the root 'causes of poverty' and target the interventions on addressing the 'causes' rather than dealing with its 'symptoms'.

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